QUARTERLY REPORT

1. **Contract No.:** DAMD17-91-C-1081

2. **Report Date:** 28 February 1992

3. **Reporting Period:** 16 November 1991 through 15 February 1992

4. **Principal Investigator:** Dr. Robert W. Verona

5. **Telephone Number:** (205) 598-6389

6. **Institution:** UES, Inc.
4401 Dayton-Xenia Road
Dayton, Ohio 45432

7. **Project Title:** Development of Data Packages on the Human Visual Response with Electro-Optical Displays.

8. **Current staff, with percent effort of each on project:**

NAME	TITLE	HOURS*	% OF EFFORT
Dr. Robert W. Verona	Engineering Psychologist	488	100%
Dr. Victor Klymenko	Research Psychophysicist	464	95%
Mr. Howard H. Beasley	Electronics Technician	488	100%
Mr. John S. Martin	Electro-optic Technician	480	98%

* 488 Hours were available during this reporting period not including holidays. The above hours are the actual hours worked (sick leave and vacation time have been subtracted).

9. **Contract expenditures to date:**

Personnel	$160,812.64	Equipment & Supplies	$ 2,947.29
Travel	$ 553.70	Other	$ 1,034.75
		TOTAL*	$165,348.38

*Does not include facilities capital and G&A expense.

10. Comments on administrative and logistical matters.

Office Space:

UES reconfigured its office space and vacated the unused areas so it could be made available to other contractor personnel.

11. Scientific Progress:

Physical Measurements:

We have measured three electro-optical displays using the various static measurement techniques presented in the literature. As expected, the measurement results differ greatly among the various techniques. These data will be presented at the SPIE Conference on Helmet Mounted Displays in Orlando in April 1992 and published in a USAARL contractor report.

The measurement technique we have accepted as being the most accurate of those examined was developed jointly among the services and industry and reported in USAARL Report 79-14, "A Direct Measure of CRT Image Quality." These results were used as a baseline to assess the other techniques and determine which techniques or combination of techniques yielded comparable results. Unfortunately, the discrete spatial frequency measurement procedure we used as the baseline measurement is very time consuming. Time is critical in our measurements because the displays used to present psychophysical stimuli must have their operating parameters measured and set precisely. The display brightness and contrast parameters tend to drift, and although these drifts are not significant for normal display viewing, they are significant when using the display to measure visual thresholds. Rapid display measurement techniques allow the display to be characterized and adjusted, if necessary, without interrupting physiological data collection.

We have been interacting with the IHADSS display manufacturer to investigate hardware modifications that will allow more precise control of the displayed image. The single turn brightness and contrast controls have been replaced with multi-turn controls allowing more precise adjustments. The brightness and contrast drift due to thermal dimensional changes inside the CRT will require more extensive hardware modifications. The filament will be continuously heated even when the display is not in use so the metal elements dimensions inside the CRT will stabilize. We are convinced by our extensive measurements that photometric monitoring is required to insure a repeatable stimulus presentation. Voltages and control position settings cannot adequately be used to insure a precise and repeatable stimulus presentation.

Set-up of the laboratory space is an on-going effort. The live video from the dual rooftop mounted cameras has been routed into the video source and distribution system. These video signals can be used to feed the dual IHADSS. Additional video test signals have also been added

to the video source options. These test signals are used with the spatial measurement software to measure the display static MTF. More test signals will be added to measure the display dynamic MTF.

Modifications to the spatial measurement software have increased its utility and enhanced its self-documentation capability. Further modifications are underway to allow the software to perform dynamic MTF measurements. This effort will be the thrust of the next quarters effort.

The luminance uniformity of the HP9000 high resolution color monitor was measured using the Prichard 1980/HP9845 measurement system. The middle portion of the display has a variation of +/- 10% and the upper and lower regions of the display have a luminance variation of +/- 5%. These variations are acceptable for the visual stimulus presentations.

A model was developed to predict the number of shades of gray from various helmet mounted display configurations. The IHADSS measurement data was used as a baseline. A video tape and photographs were produced to demonstrate the effects of the loss of shade of gray predicted by the model on image quality.

Psychophysical Measurements:

The psychophysical measurements will assess the effect on visual performance of modifications of the visual field introduced by electro-optical display systems with special attention to the specific display parameters of the new Kaiser system designed for the Comanche. The first series of visual experiments are designed to assess basic sensory changes in visual sensitivity. Later experiments will assess changes in more complex, or higher-order perceptual processes, more directly relevant to helicopter aviation per se.

In order to carry out these measurements Dr. Klymenko has designed two optional train configurations, which allow us to use the single HP monitor to present visual stimuli with up to a 50 degree field of view (each eye or total) for our planned binocular overlap experiments. The spatial and temporal resolution of the stimuli will range from 0 to 12 cpd and 0 to 30 Hz respectively; stereoscopic disparity will be limited to units of 2.5 minutes of visual angle. Some increases in spatial and disparity resolution will be possible at the expense of field of view size. The system design configuration allows for individual IPD adjustments, and computational control of binocular overlap and other stimulus display factors. The optical train fixtures are in the process of being fabricated to specification by the USAARL machinists in ongoing consultation with Dr. Klymenko. Physical anti-aliasing techniques are being considered to eliminate jagged pixel edges.

Software for stimulus generation and data collection is being written by Dr. Klymenko.

Experiments have been designed and the literature review is ongoing. The protocol for the first series of experiments has been submitted and is being staffed. These experiments will investigate the influence of binocular overlap factors (e.g., degree of overlap, size of visual fields, nearness of binocular edges) on spatial and temporal sensitivity functions. This basic sensory threshold data will be a prelude to follow-up experiments investigating higher order perceptualphenomena more relevant to piloting/targeting per se (e.g., pick up of optic flow information), as well as cognitive-attentional factors in electro-optical displays (e.g., see-through images).

12. Milestones

The static IHADSS physical measurement data will be presented at the SPIE conference in April 1992, on schedule. The software required to begin dynamic IHADSS data collection is being developed and tested. Some delays were encountered because of the GFE measurement and display hardware failures. Other delays were encountered because EG&G/Gamma Scientific has not delivered the correct documentation that corresponds to the software version we are using. The affects of these delays are not significant to the overall program schedule. The development of the psychophysical study protocol started about two months behind schedule due to the absence of the investigator. A revised protocol has been submitted for informal review. After a successful informal review, it will be forwarded through the formal approval process.

Hewlett-Packard has not been forthcoming in providing information and support for the HP9000 computer being used to provide stimuli for the psychophysical studies. The lack of functional flow diagrams of the graphics components for their software and hardware has caused unnecessary delays. The lack of interest shown by HP to support their own product line was experienced by the government buyer too as she tried unsuccessfully to affect a software maintenance/support contract.